PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1954-55

NORTHERN NIGERIA

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Cotton Research Station, Namulonge,

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Survey of Reports.

NORTHERN NIGERIA

PROGRESS REPORT FOR THE SEASON 1954-55

Planting Period: June to August.
Picking Period: November to February.
Close Season: April to June.

General Introduction.

BY

H. E. KING and M. A. CHOYCE

Season and General.

Both at Samaru and over the main cotton growing areas in general the season was a good one. Rainfall was ample, the total of 58·34 ins. for the year 1954 at Samaru being the largest recorded over a period of 31 years. Monthly totals are given in Table 1. It will be seen that the high total for the season was in part due to exceptional figures for March, April and May, well before the cotton is planted. However, the figures for August and September were also well above average and rains continued until early November.

There was prolonged waterlogging in many fields at Samaru but, on all except the poorest patches, recovery later was good and yields were high. One six-acre multiplication plot yielded 1,150 lb. of seed cotton per acre, a figure well above any previously recorded for all but very small experimental plots at Samaru.

Over the cotton belt generally the favourable conditions coupled with a 6% increase in seed issue resulted in a crop which easily surpassed all previous records for Northern Nigeria. The total number of 400 lb. bales produced for export was 185,304, made up of 180,479 bales of "Allen" (all Samaru 26C) and 4,825 bales of "Benue".

Part of this most satisfactory yield may be attributed to the generally moderate incidence of insect pests and diseases. Observations at a range of stations showed that populations of the more important pests were on the whole less than in the previous season. The more southerly areas again suffered the heaviest losses both in quantity and quality of cotton produced.

Very encouraging results were obtained in the series of tests of new strains. A probable successor to 26C, to be known as 26J, did well in both yield and spinning tests.

At Daudawa the yields of seed from the various stages of the multiplication scheme were satisfactory. At Gombe once again extremely good returns were obtained and this season there was a notable improvement in the proportion of higher grades.

TABLE 1.

SUMMARY OF METEOROLOGICAL DATA, SAMARU, 1954.

Month	Rainfall		Days Rain >0·01		Humidity				Air Temperatures °F						(1) Sunshine Daily Mean Hrs.	(2) Open Pan Evaporation Inches
	1954	1924-1954 Average	1954	1938-1954 Average	1954 a.m.	1954 p.m.	1938-1954 a.m.	1938-1954 p.m.	1954 Max.	1954 Min.	1954 Average	1938-1954 Max.	1938-1954 Min.	1938-1954 Average		
January	0·00	0·00	0	0·0	17·6	15·7	31·7	13·7	87·8	56·5	72·2	89·0	57·7	73·4	9·8	7·04
February	0·48	0·06	2	0·5	25·3	19·0	29·1	12·9	93·2	63·8	78·5	91·7	60·6	76·2	9·4	7·31
March	3·11	0·39	2	1·1	38·8	24·3	37·2	15·5	98·6	69·4	84·0	96·2	67·2	81·7	8·6	8·09
April	2·55	1·24	7	3·1	64·5	42·4	56·9	26·4	93·2	70·3	81·8	97·5	71·3	84·4	7·7	6·27
May	8·65	5·43	10	11·2	71·1	54·1	76·2	47·3	88·2	68·3	78·3	91·6	70·2	80·9	7·7	5·87
June	6·16	6·36	14	12·4	77·6	66·0	83·8	59·1	86·5	67·1	76·8	88·2	68·2	78·2	8·3	5·50
July	6·61	8·78	16	15·9	80·8	68·0	88·5	69·0	81·3	66·1	73·7	83·6	67·4	75·3	5·2	6·11
August	16·42	11·87	21	20·6	85·0	74·2	90·6	73·1	80·6	66·2	73·4	81·9	67·0	74·5	3·4	4·86
September	12·32	8·67	18	16·8	74·9	63·1	87·2	64·9	83·2	65·9	74·6	85·0	66·7	75·9	7·2	5·07
October	1·28	1·35	7	4·5	64·8	50·6	79·3	45·5	87·1	65·2	76·2	89·2	65·5	77·4	8·1	5·18
November	0·76	0·05	2	0·3	34·1	26·1	45·4	22·0	89·2	61·1	75·2	90·2	60·9	75·6	10·0	6·46
December	0·00	0·01	0	0·0	24·2	18·6	31·4	16·0	86·9	56·6	71·8	88·3	57·9	73·1	10·1	6·82
Totals	58·34	44·21	99	86·4	—	—	—	—	—	—	—	—	—	—	—	74·58
Means	—	—	—	—	54·9	43·5	61·4	38·8	88·0	64·7	76·4	89·4	65·1	77·2	8·0	—

(1) Campbell-Stokes Sunshine Recorder.

(2) From tank 6 ft. × 6 ft.; not corrected for errors due to splash.

Adequate average figures for previous seasons not yet available for sunshine or evaporation.

Since 1953, observations have been taken at 0900 hrs. and 1500 hrs. G.M.T. Earlier, observations were taken at 0800 hrs. and 1300 hrs. G.M.T.

Trials at Samaru and Daudawa again failed to show significant increases in yield following the use of insecticides. Since pest incidence was at a relatively low level, it is probable that the untreated controls were able to compensate for insect-induced shedding by further production of fruiting points.

Spraying was not successful in preventing bollworm damage to non-shedding bolls. An examination of ripe-crop samples over several seasons at Samaru and Daudawa suggests that pest attack on non-shedding bolls reduces the yield by roughly 25%. In addition, 12 to 15 per cent. of the picked crop is damaged, resulting in lowering of grade, or additional loss in weight when picking over before sale.

At Kontagora, where pest infestation is at a much higher level, large increases in yield followed repeated applications of insecticide. Here again, damage to non-shedding bolls was not prevented.

Although a close season is becoming more extensively recognised as essential to the production of better crops, its application is still very far from complete and much time and effort devoted to improving it has met with only partial success.

Efforts to obtain vigorous and persistent action by all concerned are being renewed and extended to new media—broadcast talks and loud-speaker vans.

A tour was made by Mr. King and Mr. Choyce in November-December 1954 to study the possibilities of extending and improving the cotton crop in parts of Benue, Kabba and Ilorin Provinces. This area, popularly referred to as the "Middle Belt" of Nigeria, at present produces a small crop of low quality "Grade Benue" and is in need of a more productive cash crop. The prevalence of insect pests, a strong local predilection for late planting and mixed cropping, and a prolonged rainy season (increasing the difficulty of obtaining an efficient close season) are formidable obstacles. It was thought, however, that the growth of 26C, early planted and in pure stand, could be encouraged in areas north of the Benue River with some hope of success.

Staff, Buildings and Land.

Mr. M. G. Emsley arrived at Samaru on 28th July 1954 to assist with the entomological work. Mr. King was absent on leave from 14th July to 21st September 1954. Mr. Choyce returned from leave on 10th August 1954. Mr. Lawes proceeded on leave on 8th March 1955.

The supply of suitable African staff showed no significant improvement but, with increasing experience, a greater volume of work was handled satisfactorily. The area under cotton breeding and multiplication plots at Samaru was increased to 34 acres.

Plant Breeding.

BY

H. E. KING and D. A. LAWES

Progeny Rows.

A wide range of material was handled this season. The more immediately important 26C derivatives were tested in two replicated progeny row tests, each with 49 treatments in eightfold replication. Between them these contained 92 progenies, of which 35 were judged suitable for carrying forward to further tests.

Statistical analyses revealed significant differences between progenies in seed cotton yield, bolls per plant and seeds per boll. In one of the experiments significant differences were also found between scores given for degree of leaf tattering (ascribed to mirids). Lint yields, lint length, ginning percentage and earliness of cropping all showed wide variations.

Small scale spinning tests on no fewer than 44 of the 92 progenies were carried out by the Shirley Institute, to whom grateful acknowledgments are due. Wide and interesting differences were shown to exist and there was a fair degree of agreement with expectation based on the reputation of the parent strains. Two derivatives of 49160-23 gave the strongest yarns while a third was credited with an effective length of 40/32nds of an inch. Maturity of most of these samples was high and yarn appearance fairly good to good.

A further 114 progenies derived from West African and Uganda material, including some Albars, were tested in a less precise experiment with 2 or 3 replications according to seed available. These gave little of obvious value, but some of BP52 and Albar origin were chosen to carry forward, together with a few from BAR 18/3 (ex 26C), N'Kourala and Allen from Segou (French West Africa). In general the BP52 material showed low ginning percentages and the Albar selections high variability in lint length and ginning percentage with some very low seed weights.

Hybridization.

In addition to the straight selection work a small programme of hybridization was commenced. Planned crosses were made between pairs selected from the following types: 26I (related to 26C), BAR D28 (an Allen derivative), MU8A, BP52 and Albar 474. The purpose of these crosses was to combine lint quality (e.g., from BP52) with early cropping and high yield (e.g. MU8A), high ginning percentage (from 26I) and resistance to bacterial blight (Albar 474).

In addition, mass hybridization following the "Panmixis" system was commenced using all the above-mentioned types together with Wilds Sus 16/1. This is a long-term project yielding no immediate results but intended to provide material on which to exercise selection later. It must be assumed that the exploitation of the variability within the local Allen stocks will eventually cease to give worthwhile further improvements, although there is no evidence that this point is yet being approached.

Small Bulks Test.

Small bulks derived from progenies in the previous season's breeding plots were tested in a replicated experiment with 49 treatments and 8 replications. Highly significant yield differences were obtained. Twenty-eight of these bulks were from substrains of 26C derived by repeated re-selection from single plant selections made several years ago. Analyses of the three separate characters, bolls per plant, seeds per boll and lint per seed, showed significant differences in each. Bolls per plant seemed the most important character in determining lint yield though a few of the highest yielders also had notably high lint indices. Types with large bolls (i.e. high number of seeds per boll) did not do well in this experiment with one exception (49160-23 BCP) which combined large boll with high boll number.

Spinning tests on samples from this experiment gave useful results. Lea count by strength products of several strains were significantly above that of 26C control. Strains 479-25 BCP and 49160-23 BCP were the best spinners amongst the 26C derivatives, giving yarn of high strength and fairly good appearance. Both fell short of the Uganda strain BP52 C(51)52 (which was included for comparison) in yarn strength though equalling it in yarn appearance and exceeding it in length.

Of other types included in this experiment, but not in the analyses referred to above, four Albar 51 strains gave results of interest. Two, viz. 480/2 and 503/18, were relative failures in yield, while 474 bulk gave a fair yield of seed cotton but a low ginning percentage (31·5% against 36·2% for 26C). The fourth—645—did well. It exceeded 26C in seed cotton yield and, with 34·0% ginning, it remained amongst the highest when lint yields were calculated.

Seven BP52 selections were all inferior to 26C in seed cotton yield and ginning percentage. In growth they tended to lack vigour, and two suffered notably heavy mortality of seedlings from an unknown cause.

Strains Test.

An experiment at Samaru included the eight strains appearing elsewhere in district variety tests together with 13 others. Highly significant yield differences were obtained in spite of a high standard error (5·72% of mean treatment yield). A balanced incomplete block design with 10 replications was used.

Data on bolls per plant, seeds per boll and lint index were analysed. As for the small bulks test, the highest yielders were those with high number of bolls per plant rather than high number of seeds per boll. Lint index showed rather less range but differences were highly significant and positively correlated with total lint yield per plant.

A derivative of D5 gave the highest yield, closely followed by one from 26I. Strain D5 was the ancestor of both 26C and 26I.

Lint samples from this experiment gave count by strength products showing fairly wide and significant differences between strains, with several markedly above 26C control. The D5 and 26I derivatives, however, were not markedly different from 26C. The lint quality of some of the strains which appeared also in the district variety tests is discussed later.

District Variety Tests.

The usual series of district tests was carried out by arrangement with the Agronomist and the departmental staff at the various experimental stations throughout the cotton growing areas. Twelve experiments, each an 8 × 8 Latin square, were grown with the same strains included throughout. When these tests were commenced in 1950-51 it was hoped that the results at the individual stations would be of sufficient accuracy to reveal the presence or absence of strain by locality interactions. This has not proved to be the case; the relative yields of the strains are widely different from the different stations but the standard errors are almost without exception far too high for there to be any suggestion of real locality effects.

The current season's results were in this respect worse than usual, co-efficients of variation ranging from 10·5% to 33·3% with all but two over 18%. The strain differences at individual stations were in general not statistically significant.

Omitting one site (Maigana), the yields of the remaining eleven are summarised in Table 2. It will be seen from this table that (in contrast with last season) the range in the control yield from locality

to locality was extremely wide. This does not necessarily indicate any such range in the general crop yield of the localities, but is a reflection of the state of fertility of the particular fields used in the experiments. At Samaru, for instance, both the tests were grown (deliberately) without manure; an adjacent manured field gave a yield of over 1,100 lb. of seed cotton per acre. The yield of the Maiduguri experiment is again remarkable (last season it was 797 lb.).

This locality also provides an example of the unreliability of the strain comparisons in any one year at one site. In 1953-54 the strain 479-25 gave only 94% of the seed cotton yield of the control; this season 479-25 BCP gave 128%. There is no reason to suppose that more than a fraction of this "improvement" is due to the substitution of a mass re-selection (479-25 BCP) for the older stock (479-25). At Kontagora, by way of contrast, the 479-25 line has now given, in three successive seasons, 121%, 116% and 122% of control 26C. These Kontagora tests were all under conditions giving low general yields.

Table 2.

District Variety Tests, Season 1954-55.
Seed Cotton Yields from Eleven Experiments.

Locality with yield of the control type in lb. per acre (in brackets)	*Yield of the other seven strains expressed as percentage of that of the control type. (Pure Stock 26C ex Stage D.)*							
	New Issue	479-25 *BCP*	479-25-44	479-25-97	49160-23 *BCP*	4736-112	26I/25	S.E.
Samaru Timely (374)	95	92	96	96	99	80	94	6·1
Samaru Delayed (305)	89	96	82	100	113	91	108	6·9
Daudawa Timely (232)	119	97	138	108	135	114	132	12·1
Daudawa Delayed (133)	114	153	100	128	140	87	129	13·5
Gombe Timely (381)	117	118	113	118	117	116	119	8·0
Gombe Delayed (350)	109	112	104	107	112	113	122	4·1
Gusau (505)	102	105	108	99	102	99	105	3·8
Kano (138)	97	130	128	111	97	141	107	7·7
Maiduguri (857)	98	128	97	112	111	103	97	8·7
Kontagora (124)	103	122	114	109	114	90	107	7·1
Zonkwa (245)	116	111	94	79	97	93	94	10·7

The mean overall results from the eleven sites are given in Table 3. Both a simple arithmetic mean and a weighted mean were calculated. The majority of the strain comparisons are unaltered by the weighting and for those for which previous seasons' results are available the order of merit is in fair accord with expectation.

TABLE 3.

DISTRICT VARIETY TESTS, SEASON 1954-55.

COMBINED RESULTS FROM ELEVEN EXPERIMENTS.

Strain	*Seed Cotton Yield in lb. per acre and as per cent of control type*		*Ginning Percentage*	*Lint Yield*	*Lint Length*
	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)
Pure Stock 26C (ex stage D of the Daudawa seed multiplication scheme)	333 (100)	228 (100)	34·9	79·6 (100)	32·2
New Issue 26C (ex Samaru)	346 (104)	235 (103)	34·7	81·5 (102)	32·6
26C/479-25 BCP	378 (114)	258 (113)	33·4	86·2 (108)	33·0
26C/479-25-44	346 (104)	244 (107)	35·5	86·4 (108)	33·5
26C/479-25-97	352 (106)	240 (106)	35·1	84·3 (106)	33·2
26C/49160-23 BCP	369 (111)	250 (110)	34·6	86·6 (109)	33·2
26C/4736-112	339 (102)	236 (104)	36·4	85·7 (108)	32·3
26I/25	356 (107)	251 (110)	35·6	89·3 (112)	32·7

(a) Simple mean. (b) Weighted mean; weights proportional to reciprocal of error mean square. (c) Simple mean. (d) Calculated from weighted seed cotton yields. (e) Millimetres, Bailey Halo.

It will be seen that on average each of the seven re-selections has given some advance in lint yield over the control bulk stock of 26C. This bulk represents the new nucleus stock issued from multiplication three seasons ago and as such is itself an advance on previous 26C stocks (see 1953-54 report).

The main outcome of these district tests is the confirmation that the 479-25 line fully merits immediate acceptance as a successor to 26C. It has shown itself very substantially higher yielding in terms of seed cotton and now, as represented by 479-25 BCP and the two new substrains 479-25-44 and 479-25-97, it can retain much of this advantage when yields are given as ginned lint. The lint quality of this line is discussed in detail in a later section.

Its chief competitor over the last three seasons, strain 49160-23, has done about equally well this season but lost ground last season and must be regarded as less reliable though most promising material for further selection work. Like 479-25 it is notably earlier cropping and a clear improvement over 26C in spinning quality.

Of the remaining types, 26I/25 is worthy of note as having given the highest lint yield of all. It is a newcomer to these tests and must repeat this performance before going further. The original 26I strain was of doubtful quality but the sub-strains now under trial appear to be roughly equal to 26C in yarn strength and fibre characters.

Lint Quality of 26C/479 Material.

In view of the promise shown by this material this season, and in previous tests, a considerable number of lint samples were sent for spinning. The reports on these amply confirmed those of previous seasons and were notably consistent in placing 479-25 BCP well above 26C controls in a series of pairs of samples taken from a wide range of localities.

The mean values from a number of sets of samples for some measurable hair characters and for yarn strength are given in Tables 4, 5 and 6.

Table 4.

Large Scale Spinning Tests on Samples from Samaru, Daudawa, Gombe and Maiduguri.

Character (1)	26C *Control*	479-25 *BCP*	479-25-44	479-25-97
Effective Length (64ths in.)	71	73	74	73
Maturity Ratio	·846	·869	·855	·843
Standard Hair Weight (2)	214	195	199	201
Count × Strength Product @ 32's	1769 (100%)	1866 (105)	1732 (98)	1929 (109)
Count × Strength Product @ 40's	1501 (100%)	1727 (115)	1434 (96)	1755 (117)

(1) For each character the figure given is the mean taken over 4 samples, one from each locality.

(2) In units of 10^{-5} mgm. per cm.

Table 5.

Small Scale Tests on 1954-55 Samples from Samaru, Daudawa and Gusau.

Character	26C *Control*	479-25 *BCP*	479-25-97
Effective Length	71	71	72
Maturity Ratio	·870	·863	·836
Standard Hair Weight	221	207	212
Count × Strength Product @ 40's	1659 (100%)	1852 (113)	1899 (114)

Each value is the mean for four samples, two from Samaru and one each from Daudawa and Gusau.

Table 6.

Additional Comparisons of 26C and 479-25 BCP from Small Scale Tests on Samples from Five Experiments.

	26C *Control*	479-25 *BCP*
Effective Length	72	74
Maturity Ratio	·795	·804
Standard Hair Weight	218	207
Count × Strength Product @ 40's	1853 (100%)	2002 (108%)

These figures are means of samples from Samaru, Kano, Gombe, Maiduguri and Kontagora.

It is clear from this comprehensive series of tests that the strain 479-25 BCP gives lint of consistently rather higher spinning quality. Its superiority over 26C is more marked when spun at higher counts (vide the percentage figures given in brackets in Table 4), but in all tests the slightly greater effective length and distinctly lower hair weight are accompanied by some improvement in yarn strength. In maturity it is on average at least as good; the lower hair weight is due to intrinsic fineness and not immaturity.

These conclusions follow very closely indeed those based on earlier tests on samples of the parent strain 479-25 taken from district variety tests of previous seasons. There can be no doubt that 479-25 BCP is an advance on 26C in lint quality when the two are grown side by side under a representative range of conditions in Northern Nigeria.

The comparative quality of 479-25 BCP and the two substrains 479-25-44 and 479-25-97 is brought out in Table 4. The figures follow the results of some earlier tests in placing 479-25-44 inferior to its sister strain in yarn strength though a fraction longer. This difference is not, in these samples, associated with an appreciable difference in fineness or maturity, but three tests on samples of the previous season gave 479-25-44 a rather higher hair weight as might well be expected from its distinctly higher ginning percentage. It appears that this strain must be regarded as falling short of the parent type in quality and, indeed, as no more than the equal of 26C. Substrain 479-25-97 on the other hand is right up to or possibly a slight further improvement over 479-25 BCP.

Seed Multiplication.

The usual series of small plots, containing all the strains appearing elsewhere in replicated tests, were grown for seed production and gave satisfactory yields. Included with these were plots of "Mai Inchi Allen" and "Samaru 26C Botanist's Stock" (in store since 1950). Selfed seed of both these was obtained for continued storage and future reference.

Larger plots were grown of the most promising strains. In the case of 479-25 BCP, it was found possible to sow an area of 5·8 acres using acid treated, Agrosan dressed seed at the rate of 3·6 lb. per acre (equivalent to about 4·1 lb. per acre of raw seed). Planted on 29th June, and given superphosphate at 100 lb. and sulphate of ammonia at 65 lb. per acre by placement 16 days later, this crop gave a final yield of 1,150 lb. seed cotton per acre (700 lb. of this being produced before Christmas).

This most satisfactory yield (judged in relation to the general level of yields in Nigeria) suggests very strongly that this strain can maintain in bulk growth its good showing in the small plots of the replicated yield trials. As a result of devoting so large an area to this one strain, and obtaining so high a yield per acre, the seed produced, augmented by some from its two substrains (see below), was sufficient to supply the planting requirements of the 300 acre Stage C of the Daudawa seed multiplication scheme, by-passing Stage B. This step has been agreed by the Director of Agriculture. It will cut down by one season the period required to build up sufficient seed of this strain to plant the whole Northern Nigerian cotton crop.

It has been agreed that this seed issue shall go out under the description Samaru 26J as a replacement of the latest stocks of Samaru 26C, subject of course to the results of further trials. These will continue while multiplication is proceeding.

Plots of the substrains 479-25-44 and 479-25-97 also gave good yields and produce from these was blended with that of 479-25 BCP in the following proportions:

26C/479-25 BCP	4,800 lb.	(=60%)
26C/479-25-44	1,600 „	(=20%)
26C/479-25-97	1,600 „	(=20%)
Total, ...	8,000 „	

Ginned at the Zaria ginnery this gave a ginning percentage of over 35·6% and yielded 7 full-size bales of ginned lint. The willing co-operation of the Manager, British Cotton Growing Association, in this matter is most gratefully acknowledged.

The object of the blending was primarily to give the required quantity of seed to cover the acreage of Stage C, but the addition of contributions from the two substrains will also have had the effect of raising the ginning percentage compared with that of 479-25 BCP alone.

The seven bales of lint have been presented to commercial cotton spinning concerns for trial in comparison with the current commercial

crop. Full reports are not yet to hand but preliminary indications are that the trial bales are at least fully up to the standard of the 1954-55 crop of NA1 from Zaria ginnery. A seven pound sample representative of these seven bales, sent to Shirley Institute, gave a highest standard count of 37 against 28 for a sample of Zaria NA1, and was 1/16th inch longer.

Studies of Bacterial Blight.

BY

H. E. KING and D. A. LAWES

Control of Bacterial Blight by Seed Disinfection.

Following last season's work by Mr. R. L. Burgess of Plant Protection Ltd., a trial of Agrosan GN5 was carried out. For this, a bulk of Samaru 26C seed was made by mixing samples from six ginneries to increase the likelihood of seed infection being present without having recourse to a selection not representative of the commercial crop.

Part of this seed was retained raw (i.e. fuzzy, as it comes from the saw gin) part was machine delinted (twice through the machine) and part thoroughly treated with sulphuric acid.

A portion of each of these classes was dressed with Agrosan GN5 and part was left undressed, giving six treatments for a 6 × 6 Latin square design in 36 plots of 1/28th acre.

Planting date was 6th July, and normal cultural methods were followed at a standard below the best experimental farm practice in ridging and weeding. Adequate care was taken, however, to plant exactly six seeds per hole for each class of seed.

The many detailed observations made during the season provided a mass of data. A selection of these is set out in Table 7. It is clear that the treatments had a marked effect on early growth and health. Both acid treatment and Agrosan dressing, applied separately, resulted in higher stand figures. However, one is not merely a substitute for the other; when both treatments are applied to the same seed an added improvement results. They are evidently different in their mode of action with acid treatment the more potent in improving stands and strength of early growth. With either, the improvement in the appearance of the seedlings was statistically significant and quite marked. In combination they produced seedlings very conspicuously larger than those from raw seed. This effect was obvious well before the time of appearance of the first typical symptoms of bacterial blight on seedlings from untreated seed.

TABLE 7.

COTTON SEED DISINFECTION EXPERIMENT.

	Raw.		*M.D.*		*A.T.*		*Means.*				
	U.	*D.*	*U.*	*D.*	*U.*	*D.*	*Raw.*	*M.D.*	*A.T.*	*U.*	*D.*
Stands %											
15 days from sowing	90	95	88	95	94	97	92	91	95	91	96
At end of season	80	84	76	87	89	90	82	81	89	81	87
Estimated Population as % of Seeds Sown (1)											
At thinning	51	61	47	61	65	70	56	54	68	54	64
Strength of Seedlings (2)											
Up to 22nd day	3·0	3·3	3·1	4·0	4·9	5·3	3·1	3·6	5·1	3·6	4·2
Early Bacterial Blight Symptoms Actual (3)											
30 days from sowing	49	0	35	0	6	0	49	35	6	90	0
52 days from sowing	383	4	394	17	79	4	387	411	83	856	25
Later Bacterial Blight Symptoms %											
65 days from sowing	69	22	67	23	33	22	45	43	28	55	22
79 days from sowing	84	47	85	46	59	50	64	64	54	75	47
Yields lb. Seed Cotton per Acre											
1st Picking (4)	127	111	127	130	146	125	119	128	136	133	122
%							100	108	114		
Total (5)	511	466	502	507	501	491	488	505	496	505	488
%							100	103	102		

NOTES.

Raw = Ordinary saw ginned seed. M.D. = Machine delinted (twice run). A.T. = Acid treated. U. = Undressed. D. = Dressed with Agrosan.

(1) The germination percentage of the acid treated seed was 89·5%. Six seeds were sown per stand throughout. Stands were thinned to 2 plants and thinnings counted 30 days from planting.

(2) Scored from 1 to 7 at 7, 11, 15 and 22 days, with 3=Rather weak, 4=Moderate, 5=Rather strong growth. Differences between treatments were very highly significant. S.E. for mean scores of individual treatments 0·16, for dressed and undressed 0·09, and for Raw, M.D. and A.T. means 0·11.

(3) In each case the figure is the number of stands showing some infection out of 1,700 to 1,900 stands examined. The highest figure (394) represents 25% of total stands.

(4) S.E. for individual treatment yields 6·9.
S.E. for dressed and undressed means 4·0.
S.E. for Raw, M.D. and A.T. means 4·9. (=4·1%)
Mean square for state of seed (whether Raw, M.D. or A.T.) suggested a treatment effect. Differences are in expected direction.

(5) S.E. for individual treatments 20·3.
S.E. for dressed and undressed means 11·7.
S.E. for Raw, M.D. and A.T. means 14·3 (2·9%).
No indication of any treatment effects.

In preventing the appearance of bacterial blight Agrosan was beyond question more effective, though acid treatment did definitely reduce infection. The action of Agrosan was much the same on both raw and machine delinted seed. It gave similar figures with acid treated seed, the removal of the fuzz and prior partial sterilization by the acid giving no improvement over the straight disinfection of raw seed by Agrosan alone.

The outstanding differences between treatments shown by the early counts of infected stands were progressively reduced over the period from 30th to 79th day. This is attributed to the spread of the disease from the plants which first showed it. By the 79th day the range in degree of infection had been very greatly reduced and the lowest percentage was 46%. Further spread took place after this date.

The visible damage resulting from this spread was not great. The symptoms were mainly angular leaf spot and vein blight; boll lesions were rare. It was expected, therefore, that the plots which became infected late might show an advantage in yield over those from untreated seed, at least in the early pickings. This was not so; the figures of Table 7 show no differences in favour of Agrosan dressed seed.

A difference in favour of delinted seed compared with raw appeared in the first picking but was reduced by the addition of later pickings to the total. This effect was independent of the disinfectant action of acid; it was shown by both machine delinted and acid treated seed (though more conspicuous with the latter) and in the presence of Agrosan. It is almost certainly a consequence of the better start given to the seedlings and could be of greater importance under conditions preventing the compensatory continued cropping of slower growing plants from raw seed.

In comparing these results with those obtained in 1953-54 it must be remembered that the design, the seed, the growth and the level of yields differed. In the current season's experiment the two treatments, raw undressed and machine delinted undressed, together made up a third of the total area. In the 1953-54 experiment, which gave an increase following seed disinfection, only 1/15th of the area was planted with undressed seed.

The seed used in 1953-54 was from a plot conspicuously attacked by bacterial blight and of a substrain suspected of more than normal susceptibility. It was chosen to give conditions under which Mr. Burgess could compare a range of Plant Protection products for effectiveness in destroying seed borne infection. The higher susceptibility of this substrain has since been confirmed by tests at Namulonge.

Agronomic Experiments.

BY

H. E. KING

The experiments on planting date and spacing briefly discussed in last season's report were continued. No new results of particular interest can be singled out for mention at this stage. It is hoped to

prepare a comprehensive summary for separate publication shortly. In general the conclusions already reached and recorded in the last report (planting in the first week of July with a spacing of 18 ins. × 3 ft. with two plants per stand) were fully confirmed by the results of a further season's experiments at Samaru and Daudawa.

Results from Kontagora confirmed the opinion already expressed that early planting should be extended to the Kontagora area in spite of strongly held local views to the contrary. The yields of two planting date experiments there are given later in this report (Table 15, page 23) in connection with studies of the interaction of growing conditions and insect pest control measures. The yields from different spacings at this centre show differences not previously encountered.

Experiments on cotton in rotation with other crops and as sole crop at various levels of manuring were continued. These will reach the end of the second cropping cycle after one more season, after which results can be analysed and presented.

A manurial trial with dressings of nitrogen and superphosphate at different rates and times of application gave responses to phosphate and interactions of phosphate with time of application but no response to nitrogen. This trial is being repeated at Samaru and Daudawa. It is known that nitrogenous manuring can increase yields but insufficient is known about the conditions under which this occurs.

Entomology.

BY

M. A. CHOYCE and M. G. EMSLEY

Insect Pests

Diparopsis watersi (*Roths.*). *Red Bollworm.*

Red bollworm populations at all recording stations were lower than those recorded last year. The highest incidence again occurred at Kontagora and Gombe, where peak populations of 6,300 and 4,700 larvae per acre respectively were found during early November. Very few bollworms were found at Samaru, and peaks of between one and two thousand per acre were counted at Gusau and Daudawa.

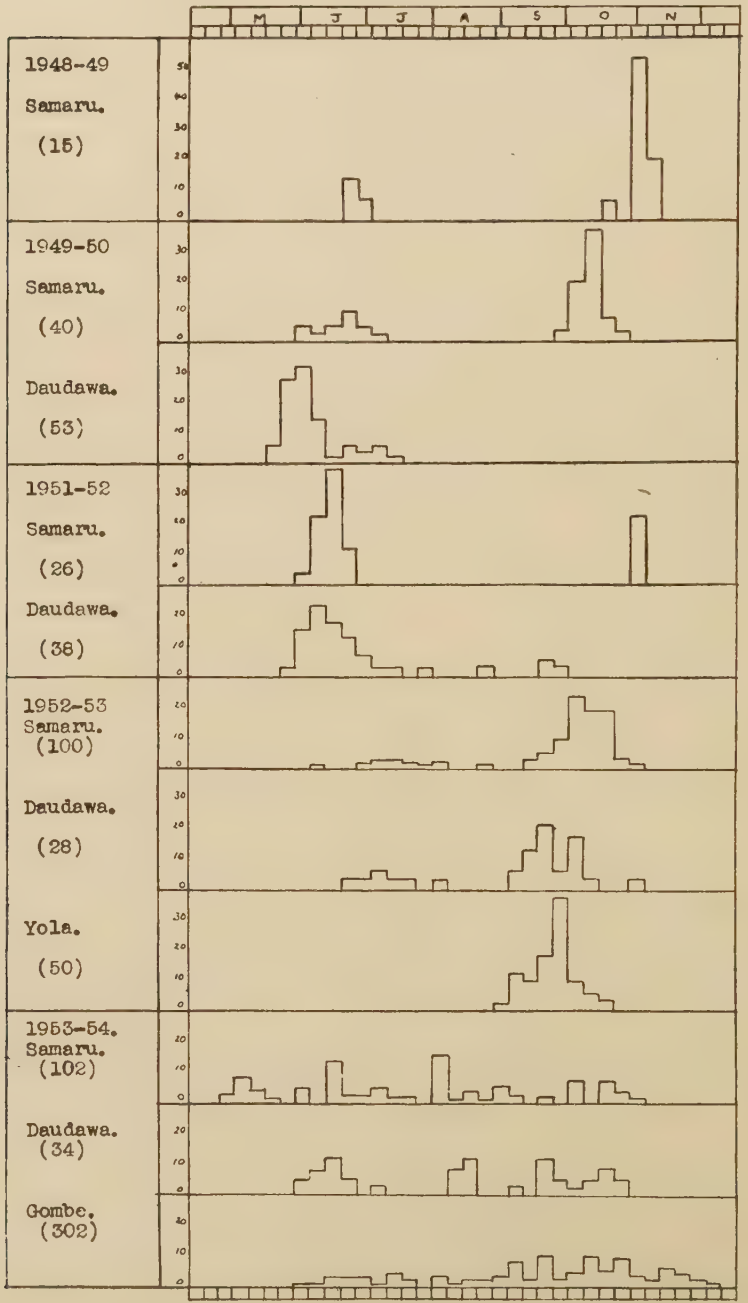
Emergence from Long Term Pupae.

The emergence of moths from pupae set in cages simulating natural conditions has been studied for a further year, and the results for the years 1948-55 are shown in Figure 1.

FIGURE 1. RED BOLLWORM: TIME OF EMERGENCE FROM LONG TERM PUPAE.

HORIZONTAL SCALE: 7-day intervals, May to November.

VERTICAL SCALE: Number of moths emerging during 7-day interval, expressed as percentage of total number of moths emerging. This total and season when pupae were set are shown at left.



A full description of the methods used and an account of the work carried out in 1948-50 has been published by Geering, Q. A. and Baillie, A. F. H. (*Bull ent. Res.*, **45**, pt. 4, pp. 661-681, 1954). The suggestion made in the Progress Report for 1953-54 that emergence might in some years be continuous is confirmed by the data from Samaru and Gombe.

The conclusion of Geering and Baillie that emergence is discontinuous and confined to June-July and October must therefore be modified. Though the overall results indicate that the number of moths emerging during these months is usually higher than during the intervening period, this tendency was less marked at Samaru and Gombe for pupae set during the 1953-54 season and emerging during the last season.

It has been confirmed in all the observations that pupae set early in the season (before November) are mainly of the short term type, with a pupal life of about three weeks; pupae set after November emerge as moths during the following season. The date at which 50% of the settings give short term and 50% long term pupae falls in all cases during the first or second week of November.

Parasitism by flies of the genus *Carcelia* over the five years at Samaru never exceeded 30% for the short term emergences, and 24% for the long term emergences, the averages being 17% and 9% respectively. The emergence of the parasite follows that of the moths very closely, even through diapause to the following season.

Platyedra gossypiella, Saund. Pink Bollworm.

The incidence of pink bollworm in the main cotton growing areas continued at a low level. As in previous seasons, the infestation in Adamawa Province was heavier than elsewhere. Table 8 gives the number of larvae from 1,000 split bolls, for all pickings combined, at several stations.

Table 8.

Pink Bollworm: Number of larvae per 1,000 split bolls.

Standard Plots:		*Peasant Farms in Adamawa Province: Numan Division.*	
Samaru	7	Guyuk 1	141
Daudawa	5	Guyuk 2	145
Kontagora	18	Bobbini	80
Gombe	17	Shellen 1	115
Gusau	27	Shellen 2	117
		Numan	167
Peasant Farms:		*Northern Adamawa.*	
Gusau 1	12	Gurde	25
Gusau 2	44	Mubi	62
Gusau 3	48	Mirinyi	60
Gusau 4	32	Uba	29

The results of an examination of samples of seed cotton from 32 selected markets are given in Table 9.

The figures for Grade II include a sample from Mayo Belwa (Gombe Ginnery area) containing 11 living and 25 dead larvae, and a sample from Shinkafe (Mai Inchi Ginnery area) containing 17 living and 13 dead larvae. Though there is a tendency for the lower grades of seed cotton to be more heavily infested, the absence of any striking differences is an indication of the relative unimportance of this bollworm in most areas.

Table 9.

Pink Bollworm. Larval Counts in Seed Cotton Samples.

Grade of Seed Cotton	*No. of 1 lb. Samples*	*Larvae inside seed*		*Larvae outside seed*	
		Living	*Dead*	*Living*	*Dead*
I	33	15	14	2	6
II	41	49	73	1	24
III	39	28	37	7	28
Totals	113	92	124	10	58

Other Bollworms.

Spiny bollworms were less common than last year, and populations were generally lower than those reported for red bollworm. Larvae of the false codling moth and American bollworm were found infrequently, though the latter was more common at Kontagora and in the more southerly cotton growing areas.

Dysdercus superstitiosus F. Cotton Stainer.

Stainers migrated into the crop during September or early October, usually breeding and remaining in the crop until harvest. At Samaru, Daudawa and Gusau populations were small, the heaviest incidence occurring at Kontagora and Gombe.

At Samaru several adults of *Dysdercus fasciatus* Sign. were found amongst large numbers of *D. superstitiosus* on 'rama' (*Hibiscus cannabinus*) during October. *D. fasciatus* was found on cotton at Kontagora, where it also occurred on baobab trees, though not with *D. superstitiosus.*

Mirid Damage.

Tattering caused by mirids was again widespread in all cotton growing areas, but the extent of the damage was very variable and at a lower level than last year.

Crop Loss.

Heaviest shedding was recorded at all stations during November, and bollworm damage to shed buds and bolls, and ripe bolls, is given in Table 10.

Table 10.

Percentage Damage by Bollworms to Shed Buds, Shed and Aborted Bolls, and to Ripe Bolls, 1954-55.

(Figures for 1953-54 in brackets.)

Station	*Shed Buds*	*Shed and Aborted Bolls*	*Ripe Bolls*
Samaru	35 (26)	12 (15)	28 (27)
Daudawa	52 (42)	23 (26)	39 (30)
Gusau	72 (57)	63 (42)	42 (37)
Gombe	44 (41)	43 (36)	21 (56)
Kontagora	37 (40)	35 (45)	89 (69)

An analysis of damage to ripe bolls is given in Table 11. The percentage of clean locks at Kontagora and in Numan Division of Adamawa Province was very low compared with other stations.

From an examination of these analyses for the past four years, it is estimated that at Samaru and Daudawa pest attack on non-shedding bolls reduces the yield by about 25%. In addition, between 12% and 15% by weight of cotton that can be picked is damaged. Losses at Gombe and Gusau are somewhat higher.

At Kontagora, where the number of non-shedding bolls is markedly reduced because of the high incidence of pests, 30% of split bolls are unpickable, and 40% by weight of the picked cotton is damaged. At Kontagora Farm Centre, for example, the actual yield of July-sown cotton this year was probably less than a fifth of the total potential yield.

Table 11.

Percentage Lock Damage in Ripe Bolls.

Station	*Clean*	*Boll-worm Partial Loss*	*Boll-worm Total Loss*	*Non Boll-worm Partial Loss*	*Non Boll-worm Total Loss*
Samaru	75	5·5	1·5	14	4
Daudawa	68	8	7	15	2
Gusau	66·5	6·5	5·5	15	6·5
Gombe	64	7	2	22	5
Kontagora	23·5	25·5	27·5	20	5·5
Gusau Peasants (Mean of 4)	60	9·5	6·5	16·5	8
N. Adamawa Peasants (Mean of 4)	60	8·5	5·5	17·5	8·5
Numan Div. Peasants (Mean of 6)	30·5	12	24·5	21	12

Insecticide Trials.

Six insecticide trials on cotton were carried out during the season. At Samaru and Daudawa the application of insecticides did not produce any marked increases in yield compared with untreated cotton; at Kontagora the results were more promising, and indicate the need for further trials in this area.

1. *Samaru.*

(a) Two strips, each of 95 ridges by 12 yards, of a cotton multiplication area were sprayed with DDT at the rate of 1 lb. DDT per acre on 22/9/54, 2/10/54 and 20/10/54, and at the rate of 2 lb. per acre on 3/11/54 and 18/11/54. Adjacent strips were left as controls.

Counts taken on five dates between 22/9/54 and 18/11/54 showed that mirid damage was low on treated and untreated cotton; damage was reduced by a quarter on the sprayed strips. Boll samples taken on 16/11/54 showed that bollworm attack was also at a low level, less than 8% of green bolls on the plants in the trial area being damaged. Spraying had practically no effect on bollworm damage.

Yields over this multiplication area averaged 766 lb. seed cotton per acre, and no obvious difference between sprayed and unsprayed strips was indicated.

(b) In a replicated trial on *barbadense* cotton, sprayed plots received 1·1 lb. DDT per acre on 20/9/54, 30/9/54 and 12/10/54, and 2·2 lb. per acre on 25/10/54, 9/11/54 and 24/11/54.

Two varieties of *barbadense,* BAR 4/16 and BLR 14/25, were included in the trial; in addition to attack from bollworms and mirids, this type of cotton is liable to suffer severe jassid damage. A comparative score for jassid damage, estimated on 17th November, is given for each variety of *barbadense* in Table 12.

Mirid damage was low, but by the end of October a moderate degree of control was achieved, tattering on the sprayed plots being reduced to 43% of that on the untreated plots. There was no difference between the two varieties of cotton.

Final yields are given in Table 12.

Table 12.

Samaru Insecticide Trial on barbadense Cotton.
Comparative Jassid Damage, and Yields in lb./acre.

	BAR 4/16		*BLR 14/25*	
	Jassid damage	*Yield*	*Jassid damage*	*Yield*
Sprayed	60	241	44	282
Unsprayed	100	206	100	285

2. *Daudawa.*

(a) A block of approximately eight acres of Stage B multiplication cotton was dusted with hand operated machines on 14/10/54, 28/10/54 and 12/11/54. The insecticide used was a "cotton dust" containing 10% DDT and 3% gamma BHC, and it was applied at the rate of 28 lb. per acre on each date.

Samples taken on 13/11/54 indicated that 28% of green bolls were damaged by bollworms in the dusted area. A smaller proportion (21%) was damaged in an adjacent area of Stage C cotton, which was planted three weeks later than Stage B.

No statistical comparison of yields from dusted and undusted cotton can be made, but examination of yields from other parts of the multiplication area shows that dusting did not give any obvious increase. The dusted area, planted on 29th June, yielded 334 lb. seed cotton per acre; an adjacent field, planted on 19th July, yielded 332 lb.

(b) A block of two acres of cotton on the multiplication farm at Shemi was sprayed with 1 lb. DDT per acre on 15/9/54, 24/9/54, 5/10/54, 14/10/54 and 28/10/54. The treatments were applied using battery knapsack sprayers.

The area of the trial was only moderately damaged by mirids before spraying began; by the middle of October spraying had reduced this by nearly half. Bollworm damage to green bolls on the sprayed area (9%) was also about half of that on unsprayed cotton (19%).

In spite of the reduction in mirid and bollworm damage, the yield of the sprayed area at 333 lb. per acre was little more than the 310 lb. per acre obtained from an equivalent area of unsprayed cotton.

3. *Kontagora.*

(a) A replicated trial covering four acres was laid down on Kontagora Land Settlement Scheme. A spray mixture containing 0·5% DDT and 0·15% gamma BHC was applied at 40 gallons per acre on 30/9/54, 14/10/54, 28/10/54, 16/11/54, 1/12/54 and 15/12/54. The cotton on the farm was sown late in the season, part on 15th August, and part on 12th September.

Green boll samples examined on 25/11/54 did not reveal any marked difference in damage by bollworms on sprayed and control plots. There was some indication that, on the August sown plots, spraying had resulted in more bolls remaining on the plants. Over the whole trial bollworms had attacked less than 10% of all the green bolls examined.

Yields of seed cotton for both sowing dates are given in Table 13.

Table 13.

Kontagora Land Settlement Scheme Insecticide Trial.
Yields in lb. per acre.

	Sown 15/8/54	*Sown* 12/9/54
Sprayed	277 (142%)	199 (119%)
Unsprayed	195 (100%)	167 (100%)

(b) On Kontagora Farm Centre the whole of a date of sowing, spacing and manurial trial of cotton was sprayed with an insecticide mixture similar to that used on the Settlement Scheme. The dates of application were: 15/9/54, 29/9/54, 13/10/54, 27/10/54, 10/11/54 and 24/11/54. A similar trial was planted and left unsprayed to serve as a comparison. While this arrangement prevented any interference with the unsprayed trial by insecticide, differences in yield between the two experiments could have been caused by effects other than the spray treatments. These differences were, however, so marked that it seems reasonable to attribute them largely to the effect of the insecticide.

Boll samples taken from all plots of one replicate in the manured and unmanured half of each trial show that the main effect of the spraying was to increase the number of bolls remaining on the plants, rather than to reduce the proportion of damaged bolls (Table 14.)

Table 14.
Kontagora Farm Centre. Insecticide Trial.
Boll samples taken on 16th November from 5 stands per plot.

	Sprayed Trial		*Unsprayed Trial*	
	Manured	*Unmanured*	*Manured*	*Unmanured*
Total Bolls	415	297	238	124
Undamaged Bolls	146	149	122	77
% Undamaged	35	50	51	62

Final yields from both trials are given in Table 15, and detailed analysis of each trial reveals the following points:

(i) The yields from different levels of fertility were significantly different (P = 1%) in the sprayed trial only.

(ii) Yields from different sowing dates were significantly different in the sprayed trial (P = 0·1%) and in the unsprayed trial (P = 1%). This is in line with results obtained elsewhere in the Northern Region, though the mid-June sowing date does not always outyield early July.

(iii) Yields from the three different spacings were significantly different in the sprayed trial (P = 1%) and in the unsprayed trial (P = 5%). The tendency of the closer spacing to give higher yields requires further investigation. Trials held over a number of years at Samaru and Daudawa have shown that in these areas yields from all three spacings are similar.

The results of the trials at Kontagora clearly demonstrate that the highest increases in yield following the use of insecticides come from cotton growing under optimum conditions. The cotton plant should be capable of producing a reasonable yield in the absence of pests; low yields resulting from late planting or lack of fertility cannot be compensated for by using insecticides.

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TABLE 15.

KONTAGORA FARM CENTRE.

YIELDS IN LB./ACRE SEED COTTON FROM SPRAYED TRIAL (A) AND UNSPRAYED TRIAL (B).

		Manured				*Unmanured*				*Grand Mean*
		s_1	s_2	s_3	*Mean*	s_1	s_2	s_3	*Mean*	
A	d_1	690	519	380	530	261	227	225	238	384
B		187	161	99	149	68	62	46	58	104
A	d_2	268	333	266	289	205	209	171	195	242
B		74	64	57	65	85	66	91	81	73
A	d_3	186	150	126	154	85	88	112	95	124
B		69	71	95	78	71	61	53	62	70
A	d_4	100	69	55	75	21	23	35	26	51
B		25	28	22	25	36	29	25	30	27
A	*Means*	311	268	207	262	143	137	138	139	200
B		89	81	68	79	65	55	54	58	69

Dates of Sowing

d_1 — 20/6/54
d_2 — 11/7/54
d_3 — 1/8/54
d_4 — 22/8/54

Spacing

s_1 — 9 inches
s_2 — 18 inches
s_3 — 27 inches
(on 3 ft. ridges)

Manure

The manured plots received 3 tons/acre F.Y.M., 112 lb./acre Superphosphate and 56 lb./acre Sulphate of Ammonia.

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